Health Consultation

Les' Radiator and Ron's Heavy Equipment
Bremerton, Kitsap County, Washington

October 24, 2001

Prepared by
The Washington State Department of Health
under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Foreword

The Washington State Department of Health (DOH) has prepared this health consultation in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste. This health consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this health consultation is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. Health consultations focus on specific health issues so that DOH can respond quickly to requests from concerned residents or agencies for health information on hazardous substances. DOH evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health.

For additional information or questions regarding DOH, ATSDR or the contents of this health consultation, please call the health advisor who prepared this document:

Gary Palcisko
Public Health Advisor
Washington State Department of Health
Office of Environmental Health Assessments
PO Box 47846
Olympia, WA 98504-7846
Phone: (360) 236-3377
Fax: (360) 236-3383
Toll free: 1-877-485-7316
Web site: www.doh.wa.gov/ehp/oehas/default.htm

Glossary

Acute	Occurring over a short period of time. An acute exposure is one which lasts for less than 2 weeks.
Agency for Toxic Substances and Disease Registry (ATSDR)	The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of the U.S. Department of Health and Human Services.
Aquifer	An underground formation composed of materials such as sand, soil, or gravel that can store and/or supply groundwater to wells and springs.
Cancer Slope Factor	A number assigned to a cancer causing chemical that is used to estimate it's ability to cause cancer in humans.
Carcinogen	Any substance that can cause or contribute to the production of cancer.
Chronic	A long period of time. A chronic exposure is one which lasts for a year or longer.
Comparison value	A concentration of a chemical in soil, air or water that, if exceeded, requires further evaluation as a contaminant of potential health concern. The terms comparison value and screening level are often used synonymously.
Contaminant	Any chemical that exists in the environment or living organisms that is not normally found there.

Dose	A dose is the amount of a substance that gets into the body through ingestion, skin absorption or inhalation. It is calculated per kilogram of body weight per day.
Environmental Media Evaluation Guide (EMEG)	A concentration in air, soil, or water below which adverse non-cancer health effects are not expected to occur. The EMEG is a *comparison value* used to select contaminants of potential health concern and is based on ATSDR's *minimal risk level* (MRL).
Exposure	Contact with a chemical by swallowing, by breathing, or by direct contact (such as through the skin or eyes). Exposure may be short-term (acute) or long-term (chronic).
Groundwater	Water found underground that fills pores between materials such as sand, soil, or gravel. In aquifers, groundwater often occurs in quantities where it can be used for drinking water, irrigation, and other purposes.
Hazardous substance	Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.
Indeterminate public health hazard	Sites for which no conclusions about public health hazard can be made because data are lacking.
Ingestion rate	The amount of an environmental medium which could be ingested typically on a daily basis. Units for IR are usually liter/day for water, and mg/day for soil.
Inorganic	Compounds composed of mineral materials, including elemental salts and metals such as iron, aluminum, mercury, and zinc.

Lowest Observed Adverse Effect Level (LOAEL)	LOAELs have been classified into "less serious" or "serious" effects. In dose-response experiments, the lowest exposure level at which there are statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its appropriate control.
Media	Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.
Minimal Risk Level (MRL)	An amount of chemical that gets into the body (i.e., dose) below which health effects are not expected. MRLs are derived by ATSDR for acute, intermediate, and chronic duration exposures by the inhalation and oral routes.
Model Toxics Control Act (MTCA)	The hazardous waste cleanup law for Washington State.
No Observed Adverse Effect Level (NOAEL)	The dose of a chemical at which there were no statistically or biologically significant increases in frequency or severity of adverse effects seen between the exposed population and its appropriate control. Effects may be observed at this dose but were judged not to be "adverse."
Oral Reference Dose (RfD)	An amount of chemical ingested into the body (i.e., dose) below which health effects are not expected. RfDs are published by EPA.
Organic	Compounds composed of carbon, including materials such as solvents, oils, and pesticides which are not easily dissolved in water.

Parts per billion (ppb)/Parts per million (ppm)	Units commonly used to express low concentrations of contaminants. For example, 1 ounce of trichloroethylene (TCE) in 1 million ounces of water is 1 ppm. 1 ounce of TCE in 1 billion ounces of water is 1 ppb. If one drop of TCE is mixed in a competition size swimming pool, the water will contain about 1 ppb of TCE.
Route of exposure	The way in which a person my contact a chemical substance that includes ingestion, skin contact and breathing.
U.S. Environmental Protection Agency (EPA)	Established in 1970 to bring together parts of various government agencies involved with the control of pollution.
Volatile organic compound (VOC)	An organic (carbon-containing) compound that evaporates (volatilizes) easily at room temperature. A significant number of the VOCs are commonly used as solvents.

Background and Statement of issues

This health consultation was prepared at the request of the Bremerton-Kitsap County Health District to evaluate the potential health hazard posed by contaminants in soil to residents living near Les' Radiator and Ron's Heavy Equipment Repair, Bremerton, Kitsap County, Washington. DOH prepares health consultations under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

Les' Radiator and Ron's Heavy Equipment Repair are two separate active businesses located at 3285 Northlake Way. The area is residentially zoned, however, business activities have reportedly been occurring on the site since the 1950s.[1] Numerous complaints have been fielded by the Bremerton-Kitsap County Health District pertaining to the improper disposal of radiator contents, petroleum products, and sludge.[2]

The entrance to the property is a gravel drive that leads up to a wood frame building that houses Les' Radiator in the south side of the building, and Ron's Heavy Equipment Repair in the north side. An apartment with two occupants is currently located on the second floor of the structure.

Les' Radiator has operated at the site since 1987 on the ground floor of the wood frame structure.[3] The interior of the shop contains a large radiator test tank in the center, acetylene tanks and torches, 55 gallon drums, 5 gallon pails, and other miscellaneous objects. The shop is very cluttered, and the floor of the shop appears to be bare soil, or possibly thick dirt on top of concrete or gravel.

The Bremerton-Kitsap County Health District took soil samples from the site in April 2001. Samples were analyzed for metals, total petroleum hydrocarbons (TPHs), and semi-volatile organic compounds (SVOCs). Two soil samples from the dirt floor inside the shop had lead concentrations of 182,480 and 164,006 parts per million (ppm) and cadmium levels of 21 and 13.9 ppm. Other metals, TPH and SVOCs were also found in these samples above health screening values (Table 1). An outdoor soil sample taken from the front of the radiator shop had lead levels of 4,834 ppm indicating contamination might not be limited to the inside of the radiator shop.

Metal contamination in and around the radiator shop is likely the result of melting solder from damaged radiators during the repair process. Solder normally contains mostly lead and tin along with smaller amounts of cadmium, copper, silver, zinc, and other metals. The TPH found in the shop dirt is likely due to spilled cleaning solvent. The extreme levels of lead and other metals found in the radiator shop are likely due to poor housekeeping.

Ron's Heavy Equipment Repair operates out of a larger portion of the building and property. A storage yard of roughly 4-5 acres is full of scrap automobiles, barrels, batteries, construction equipment, appliances, and loads of other scrap materials. The ground throughout much of the storage yard consists of a gravel drive, but other areas are vegetated.

Table 1 - Contaminants of concern in soil around Les' Radiator

and Ron's Heavy Equipment Repair located in Bremerton, WA.

Soil Sample	Location	Contaminant Exceeding Screening Value	Concentration (ppm)	Screening Value (ppm)	Screening Value Source
1	Radiator Shop Floor	Lead	182,480	250	MTCA (A)[a]
		Cadmium	21.0	10	EMEG (child)[b]
		Copper	3972	2960	MTCA (B)[c]
		TPH-Dx [d]	63,100	2000	MTCA (A)
		Bis (2-ethylhexyl) phthalate	82.0	71.4	MTCA (B)
2	Radiator Shop Floor	Lead	164,006	250	MTCA (A)
		Cadmium	13.9	10	EMEG (child)
		Copper	3,734	2960	MTCA (B)
		TPH-Dx	14,000	2000	MTCA (A)
3	Outdoor (in front of radiator shop)	Lead	4,834	250	MTCA (A)
4	Directly outside north side of Ron's Heavy Equipment bldg	TPH-Dx	6,030	2000	MTCA (A)
5	Directly outside west side of Ron's Heavy Equipment bldg	TPH-Dx	3,750	2000	MTCA (A)
6	Equipment/junk yard	Chromium (total)	161	64	MTCA (B)
		TPH-Dx	11,100	2000	MTCA (A)
7	Equipment/junk yard	TPH-Dx	9,960	2000	MTCA (A)
8	Equipment/junk yard	Lead	533	250	MTCA (A)

Note: all samples had concentrations of beryllium that exceeded MTCA (B) cleanup values, however none of the concentrations exceeded background levels found in Washington State.

[a] Model Toxics Control Act Method A - Soil Cleanup Level for Unrestricted Land Use

[b] Environmental Media Evaluation Guide - Child Chronic Exposure

[c] Model Toxics Control Act Method B - Soil Cleanup Level

[d] Total Petroleum Hydrocarbons - Diesel Range

Of specific concern is the improper disposal of petroleum products drained from the vehicles.

Past inspections by county health department personnel have reported improper storage of waste oil in a wide array of containers ranging from uncovered five gallon buckets to a 600 gallon dumpster. Hydrocarbon staining of soil was noticed in many areas of the property. A small gasoline spill of approximately 2 - 3 gallons was also witnessed by health department personnel while conducting a walk-through of the property. Five soil samples taken in April 2001 revealed levels of lead, chromium, and TPH that exceeded MTCA residential cleanup levels. Panels thought to contain asbestos were stacked at the north end of the property. These stacks were uncovered and subject to weathering.

Access to the heavy equipment yard is not completely restricted. There is a gate along the main driveway, but it appears to be kept open.

Lead contamination in the heavy equipment repair yard soil could have resulted from a variety of sources including batteries, paint, etc. while the TPH is the result of improper storage and spilling of waste oil/fuel.

Several residences are located on or near both businesses. Two occupied mobile homes are situated among the equipment and scrap in the storage yard. Each mobile home apparently houses a single adult tenant. At least three other houses are located within 200 ft. One of the houses is home to a contract employee of the radiator shop and his child. An occupied apartment is located on the second floor of the shop building. No children 6 years of age or younger were identified in any of these homes.

At least two public and eleven private wells are located within 2000 ft of the property. [2] All public wells are required to conduct scheduled sampling for a variety of contaminants, and both wells have shown no indication of VOC or inorganic chemical contamination; however, the potential for TPH and inorganic chemical contamination of wells exists. Furthermore, private wells are not required to be tested, and therefore may be contaminated without the users knowledge. A majority of the nearby private wells are located uphill from the site, and therefore may not be impacted, assuming that the groundwater movement in the shallow aquifer follows the terrain. The groundwater flow and contamination around the site, however, has not been characterized, and it cannot be assumed that the nearby public or private wells are not potentially impacted by chemical contamination from the businesses.

Discussion

Numerous chemicals have been found in soil at Les' Radiator and Ron's Heavy Equipment that exceed health screening values. The presence of hazardous chemicals above health screening values does not necessarily represent a threat to public health. People must come into contact with the chemical, and the chemical must enter and be absorbed by the body before it can cause harm. Routes in which chemicals can enter the body are inhalation, ingestion, and dermal absorption. The following discussion will address potential exposure and health hazards associated with the contaminants found in on-site soil. The major routes of exposure associated with contaminants at the site are accidental ingestion of soil and inhalation of fumes and dust. Dermal contact is also a potential route of TPH exposure. Metals do not easily pass through the skin, therefore, dermal absorption of metals is of less concern than other routes of exposure.

Health Effects and Pathways of Concern

Lead

Lead was found at levels above the MTCA cleanup levels in 4 out of 8 samples. Three of the samples were associated with the radiator shop and contained alarming levels. The other sample was taken from the heavy equipment repair yard.

Lead is a naturally occurring element that is found at low levels in undisturbed soils. In the Puget Sound region of Washington State, the background soil lead concentration ranges between 5 and 30 ppm.[4]

Past uses of lead in paint, gasoline, plumbing, pesticides and canning have contributed to wide-spread dispersion of lead and subsequent human exposure. Elimination of lead in gasoline and solder used in canning has greatly reduced exposure to lead through inhalation and ingestion pathways. As a result, the number of one to 5-year-old children in the U.S. with elevated blood lead levels has dropped from 88.2% in the late 1970s, to 4.4% in the early 1990s.[5] Currently, the main pathways of lead exposure in children are ingestion of paint chips, contaminated soil and house dust, and drinking water in homes with old plumbing.

Lead can cause a wide array of health effects in different systems of the body, but the primary target is the nervous system. Children less than seven years old are more susceptible to lead exposure and more sensitive to its toxicity than adults. Health effects include decreased IQ, decreased attention span, and irritability.[6] The Centers for Disease Control (CDC) considers a level of 10 µg/dl or more to be an indication of excessive lead exposure.

Worker exposure to lead in radiator shops is a common phenomenon.[7, 8] When solder is melted from old radiators, it can cause lead and other metals to become airborne. Therefore, workers at Les' Radiator shop may be exposed to metals through inhalation. If inhaled, metals can pose serious health hazards to workers in a shop atmosphere especially if proper industrial hygiene controls are not in place (e.g., respirators, ventilation fans). Furthermore, the contaminated dirt found on the shop floor at Les' Radiator can be resuspended through daily activity and contribute to exposure through inhalation. Workers can also be exposed to lead through soil and dust ingestion. Lead in dust that adheres to hands can be inadvertently ingested via hand to mouth contact such as eating food.

Lead found at high concentrations in the soil near the front of the shop indicates that lead contamination is not limited to the inside of the shop. The migration of lead and other contaminants from the interior of shop to the exterior is of concern considering the proximity of residences surrounding the shop, as well as the apartment on the second floor of the structure. There are several possible pathways of exposure for residents living near the radiator shop:

Fumes created during radiator repair could expose nearby residents to metals through inhalation , especially those living in the apartment located on the second floor of the radiator shop building. Furthermore, metal dust created during radiator cleaning may also impact the yard soil and house

dust of these residences and contribute to exposure through inadvertent soil and dust ingestion or inhalation of dust.

Contaminants from the shop might also be transported on the shoes or clothing of workers. Workers in the radiator shop can inadvertently bring contaminants into their homes where their families can be exposed. A study of New York city radiator repair workers and their children showed several children with blood lead levels exceeding the CDC's current guidelines.[9]

Lead associated with the heavy equipment yard is of significantly less concern. Assuming exposure to the maximum concentration of lead found in soil at the site, 533 ppm, the EPA's Integrated Exposure Uptake Biokinetic Model (IEUBKwin - model 1.0) predicts that blood lead levels of children who play frequently in this area would not likely exceed a level of concern. Though the EPA's recently announced lead hazard standards define lead levels above 400 ppm in bare soil of a play area as being hazardous,[10] the repair yard is not likely to be an area where children frequently play.

Other Metals

Cadmium and Copper were detected in both samples collected from the radiator shop floor, and chromium was detected in one sample from the heavy equipment repair yard, at levels that exceeded screening values. Scenarios involving soil ingestion of these metals were used to calculate an estimated exposure dose (Appendix A). The inhalation route of exposure was not evaluated due to lack of information concerning air contaminants. The estimated dose for each contaminant under each scenario was compared to ATSDR's minimal risk level (MRL) or EPA's oral reference dose (RfD). MRLs and RfDs are doses below which non-cancer adverse health effects are not expected to occur (so called "safe" doses). Due to uncertainty, RfD's and MRL's are set well below levels where toxic effects have been observed. If a dose exceeds the MRL or RfD, this indicates only the potential for adverse health effects. The higher the estimated dose is above the MRL or RfD, the closer it will be to the toxic effect level. Oral cancer potency factors were not available for any of the metals of concern, and therefore cancer risk was not evaluated.

People that work in the radiator shop may be exposed to cadmium and copper through inhalation of fumes and dust, soil ingestion, and dermal absorption. Assuming only the soil ingestion route of exposure, workers would not exceed the MRL or RfD for non-cancer effects from cadmium. There is currently no MRL or RfD for copper; however, the worker's calculated dose for copper was more than one order of magnitude below a lowest observed adverse effect level (LOAEL).[11] The LOAEL in this instance was based on gastrointestinal discomfort in humans.

MRLs and RfDs

Minimal risk levels (MRLs) and oral reference doses (RfDs) are levels of exposure to chemicals below which non-cancer effects are not expected. MRLs are set by ATSDR for acute, intermediate and chronic exposure. EPA sets RfDs based on chronic exposure only. An MRL or RfD is derived by dividing a LOAEL or NOAEL by "safety factors" to account for uncertainty and provide added health protection.

Children playing in the repair yard may be exposed to chromium. Assuming children are exposed to the maximum chromium concentration in soil of 161 ppm, the estimated daily exposures for children does not exceed the RfD for chromium (VI), the most toxic form of chromium. Therefore,

children exposed to chromium through ingestion of surface soils, are unlikely to experience non-carcinogenic adverse health effects.

Total petroleum hydrocarbons (TPH)

Total Petroleum Hydrocarbons were detected in six of eight soil samples at levels that exceeded the MTCA cleanup level of 2000 ppm. Two of the samples were within the radiator shop while the other four were located in the heavy equipment repair yard.

TPH analysis is used to determine if petroleum contamination has occurred at a site. It can be a mixture of hundreds of chemical compounds that originated from crude oil. Health effects of TPH, however, are uncertain because there is a broad range of possible chemicals with varying toxicity contained within TPH. Because it is uncertain as to what individual chemicals are in a given sample, pyrene is used as a surrogate to evaluate exposures that might be considered excessive. The toxicity of pyrene is likely to be greater than that of TPH, therefore, its use as a surrogate is considered to be protective of human health.[12] The oral reference dose (RfD) for pyrene is 0.03 mg pyrene per kg body weight per day (mg/kg/day).[12] This number is based on kidney effects in mice, and has built-in factors designed to be protective of humans.

The estimated exposure of an adult worker through soil ingestion and dermal contact, to the maximum level of TPH in the radiator shop (63,100 ppm) exceeds the RfD for pyrene. Though the calculated dose is more than two times greater than the RfD, ingestion and dermal exposure to TPH in the shop environment is not likely to cause adverse health effects because conservative assumptions are used in calculating a dose.

TPH was detected at levels of concern in soil samples through out the heavy equipment repair yard. Workers in the repair yard are likely exposed to petroleum products on a regular basis through their occupation, and petroleum found in the soil represents an additional pathway in which they may be exposed through soil ingestion or dermal absorption.

Residents living in mobile homes situated in the repair yard may be exposed to TPH in the soil. These residents are currently adults, so the amount of exposure through soil ingestion is less significant than if children were living in the mobile homes. Residents can track contaminants into their homes contributing to additional exposure through dust inhalation and ingestion. Another possible pathway of exposure to TPH is the volatilization of contaminants from soil and subsequent inhalation by residents. There is no existing data from the site to quantify this pathway.

Other residents can potentially be exposed to contaminants in soil because access to the site is not completely restricted. The likelihood of the heavy equipment yard being used by nearby residents, however, is minimal because the site is cluttered with scrap equipment, and not conducive to general uses such as recreation or gardening. In the event that children actually do

play on the site, physical hazards would also be of concern as there are numerous sharp, rusty, heavy objects through out the yard.

The average TPH level in the equipment yard soil is 6,394 ppm. A child that frequently plays in

the heavy equipment repair yard would receive a dose nearly triple the oral RfD for pyrene based on exposure assumptions (appendix A). While a child is not likely to play frequently in the equipment yard, the presence of high levels of contamination near a residential area cannot be ignored.

Also of concern is the potential for contaminating drinking water supplies. Though public well systems in the area do not appear to be currently contaminated, continued spilling of petroleum may eventually contaminate them. Furthermore, there are a number of private wells nearby that are not subject to routine testing. If contamination of these wells were to occur, the users would be unaware.

Bis (2-ethylhexyl) phthalate

Bis (2-ethylhexyl) phthalate (BEHP) was detected in the shop dirt at concentrations above MTCA cleanup levels. It has uses including but not limited to plasticizing polyvinylchloride, insect repellant formulations, cosmetics, rubbing alcohol, liquid soap, detergents, and decorative inks.[13]

There is no human data available concerning the carcinogenicity of BEHP; however, the EPA has classified it as a B2 carcinogen based on significant dose-related increases in liver tumors in animal studies.

Cancer risk is estimated by calculating a dose and multiplying it by a cancer potency factor, also known as the cancer slope factor. Cancer potency factors are derived from human population data or laboratory animal studies involving doses much higher than are encountered in the environment. Use of animal data require extrapolation of the cancer potency obtained from these high dose studies down to real-world exposures. This process involves much uncertainty. Current thinking suggests that there is no "safe dose" of a carcinogen and that a very small dose of a carcinogen will give a very small cancer risk. Cancer risk estimates are, therefore, not *yes/no* answers but measures of chance (probability). Such measures, however uncertain, are useful in determining the magnitude of a cancer threat since any level of a carcinogenic contaminant carries an associated risk. The validity of the "no safe dose" assumption for cancer-causing chemicals is not clear. Some evidence suggests that certain chemicals considered to be carcinogenic, including BEHP, must exceed a threshold of tolerance before initiating cancer.

DOH considers cancer risk to be not significant when the estimate results in less than one cancer per one million exposed over a lifetime. The reader should note that these estimates are for *excess* cancers that might result in addition to those normally expected in an unexposed population. The calculated risk to workers in the radiator shop from exposure to BEHP is 4.2 x $10,^{7}$ or 4.2 excess cancers per 10,000,000 exposed over a lifetime. Therefore, bis (2-ethylhexyl) phthalate in the radiator shop environment is not considered to be a significant cancer risk to workers.

Asbestos

Asbestos is a general term used to describe a group of fibrous minerals that occur naturally in the environment. Inhalation of airborne particles of asbestos over long periods of time has been

shown to cause lung diseases including asbestosis (a condition where lung tissue becomes heavily scarred and stiff), and lung cancer.

Asbestos containing materials (panels) stored on the site are uncovered and subject to the elements. These materials may become friable, brittle or readily crumbled, over time. It is not clear what the intended use of these panels is, but if disturbed, people can be exposed to asbestos laden dust.

Child Health Initiative

ATSDR recognizes that infants and children may be more vulnerable to exposures than adults when faced with contamination of air, water, soil, or food.[14] This vulnerability is a result of the following factors:

- Children are more likely to play outdoors and bring food into contaminated areas.
- Children are shorter and their breathing zone is closer to the ground, resulting in a greater likelihood to breathe dust, soil, and heavy vapors.
- Children are smaller and receive higher doses of chemical exposure per body weight.
- Children's developing body systems are more vulnerable to toxic exposures, especially during critical growth stages in which permanent damage may be incurred.

In order to account for these factors, exposure scenarios involving children were calculated to estimate their doses in situations where they were potentially exposed to chemical contaminants.

Conclusions

An indeterminate public health hazard exists for children and adults exposed to contaminants in and around Les' Radiator and Ron's Heavy Equipment Repair. Soil sampling has revealed extremely high concentrations of lead, other metals, and TPH within Les' Radiator. An apparent lack of industrial hygiene controls in the radiator shop indicates that workers are exposed to these contaminants. Nearby residences may also be impacted due to migration of the contaminants from the shop interior to residential house dust or soil. Therefore, exposure to lead, cadmium other metals may be occurring to residents near Les' Radiator.

Soil sampling from the yard of Ron's Heavy Equipment Repair revealed the presence of TPH, lead, and chromium at levels of concern. Lead and chromium in the repair yard appear to be of minimal concern, however, exposure to TPH may be occurring. Two mobile homes are situated in the repair yard, and the site is not restricted; therefore, residential exposure to TPH through inadvertent soil or dust ingestion cannot be ruled out. Though the latest samples from nearby drinking water systems were free of VOC contamination, continued spilling of petroleum products in the heavy equipment yard could impact drinking water sources in the future.

Concern for worker safety in the radiator shop prompted the involvement of the Washington State Department of Labor and Industry (L&I). A representative from L&I has made a site visit to determine if a hazardous environment does indeed exist in the workplace.

Recommendations / Public Health Action Plan

1. An exposure investigation is planned for residents living above or near the radiator shop. Yard soil and house dust samples will be collected in order to determine if residences are being impacted by the radiator shop. Furthermore, a blood lead test will be offered to determine if residents are exposed to lead. Participation will be voluntary.

2. Access to the heavy equipment repair yard should be restricted in order to prevent children or trespassers from wandering onto the site.

3. Waste oil should be disposed of properly in order to prevent future spills.

4. Nearby wells downgradient should be sampled for TPH and metals.

5. Asbestos should be removed from the site by a certified asbestos removal contractor.

Preparer of Report

Gary Palcisko
Public Health Advisor
Office of Environmental Health Assessment
Washington State Department of Health

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Total Population	**3538**
White	**3081**
Black	**159**
American Indian, Eskimo, Aleut	**43**
Asian or Pacific Islander	**226**
Other Race	**29**
Hispanic Origin	**147**
Children Aged 6 and Younger	**574**
Adults Aged 65 and Older	**334**
Females Aged 15 - 44	**803**
Total Aged over 18	**2368**
Total Aged under 18	**1170**
Total Housing Units	**1292**

***Calculated using the area proportion technique. Source: 1990 U.S. CENSUS**

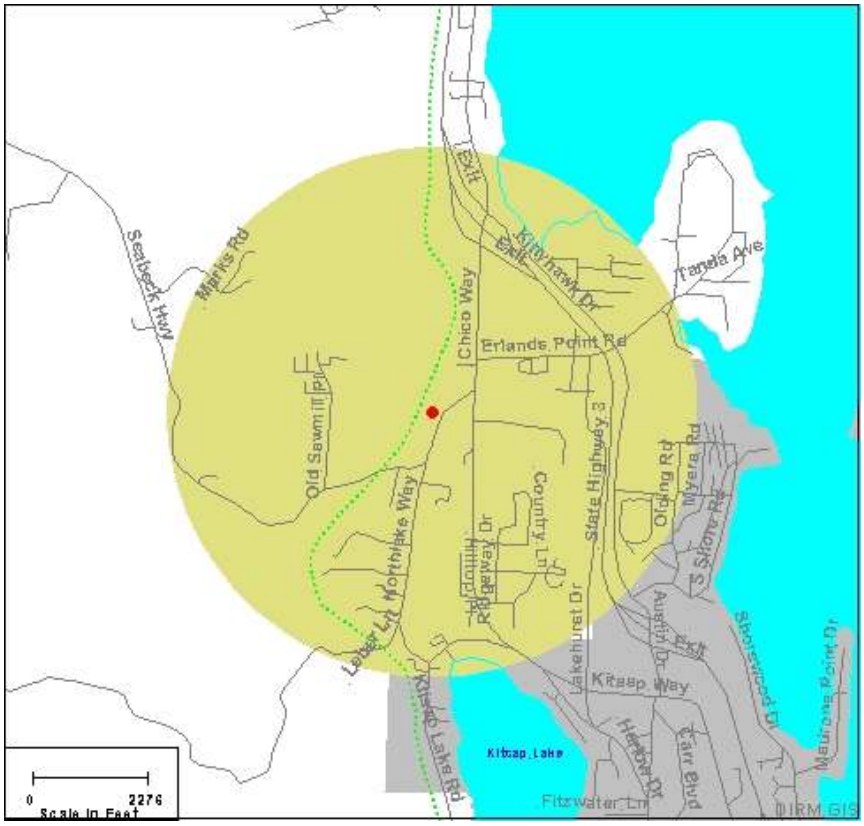

Figure 1 - Demographic Statistics Within One Mile of the site*

Appendix A: Exposure Calculations

Soil Ingestion Route of Exposure

Variables:
Ingested Dose (ID)
Soil Concentration (Cs)
Ingestion Rate (IR)
Conversion Factor (CF)
Exposure Frequency (EF)
Exposure Duration (ED)
Soil Matrix Factor (SMF)
Body Weight (BW)
Averaging Time (AT)

$$ID = \frac{CS * IR * CF * EF * ED * SMF}{BW * AT}$$

Dermal Absorption Route of Exposure

Dermally Absorbed Dose (DAD)
Adherence Factor (AF)
Absorption Factor (ABS)
Adherence Duration (AD)
Oral Route Adjustment (ORAF)
Surface Area (SA)

$$DAD = \frac{CS * AF * ABS * AD * CF * EF * ED * SA}{ORAF * BW * AT}$$

Cadmium: RfD = 0.0005 mg/kg-day

Assumptions:
Adult worker
CS = 21.0 mg/kg
IR = 50 mg/day
CF = 0.000001 kg/mg
EF = 250 days/yr
ED = 5 yr
SMF = 1
AT = 1825 days
BW = 72 kg

$$\frac{21.0 * 50 * 0.000001 * 250 * 5 * 1}{72 * 1825}$$

= 0.00001 mg/kg - day

Chromium (VI): RfD = 0.003 mg/kg-day

Child Playing in Repair Yard
CS = 161 mg/kg
IR = 200 mg/day
CF = 0.000001 kg/mg
EF = 350 days/yr
ED = 5 yr
SMF = 1
AT = 1825 days
BW = 15 kg

$$\frac{161 * 200 * 0.000001 * 350 * 5 * 1}{15 * 1825}$$

= 0.002 mg/kg - day

Copper: LOAEL = 0.05 mg/kg-day

Assumptions:
Adult worker
CS = 3972 mg/kg
IR = 50 mg/day
CF = 0.000001 kg/mg
EF = 250 days/yr
ED = 5 yr
SMF = 1
AT = 1825 days
BW = 72 kg

$$\frac{3972 * 50 * 0.000001 * 250 * 5 * 1}{72 * 1825}$$

= 0.002 mg/kg - day

TPH: RfD (pyrene) = 0.03 mg/kg-day

Assumption 1:
Adult Worker in Radiator shop
CS = 63100 mg/kg
IR = 50 mg/day
CF = 0.000001 kg/mg
EF = 250 days/yr
ED = 5 yr
SMF = 1
AT = 1825 days
BW = 72 kg
AF = 0.2 mg/cm2
ABS = 0.13
AD = 1 day
ORAF = 1
SA = 2500 cm2

$$\frac{63100 * 50 * 0.000001 * 250 * 5 * 1}{72 * 1825} +$$

$$\frac{63100 * 0.2 * 0.13 * 1 * 0.000001 * 250 * 5 * 2500}{1 * 72 * 1825}$$

= 0.069 mg/kg - day

Assumption 2:
Child playing in heavy equipment repair yard
CS = 6394 mg/kg (mean of 5 samples)
IR = 200 mg/day
CF = 0.000001 kg/mg
EF = 350 days/yr
ED = 5 yr
SMF = 1
AT = 1825 days
BW = 15 kg
AF = 0.2 mg/cm2
ABS = 0.13
AD = 1 day
ORAF = 1
SA = 2900 cm2

$$\frac{6394 * 200 * 0.000001 * 350 * 5 * 1}{15 * 1825} +$$

$$\frac{6394 * 0.2 * 0.13 * 1 * 0.000001 * 350 * 5 * 2900}{1 * 15 * 1825}$$

= 0.11 mg/kg - day

Bis (2-ethyl) phthalate: Oral Slope Factor = 0.014 kg-day/mg

Worker in radiator shop

CS = 82
IR = 50 mg/day
CF = 0.000001 kg/mg
EF = 250 days/yr
ED = 25 yr
SMF = 1
AT = 27375 days
BW = 72 kg
AF = 0.2 mg/cm2
ABS = 0.1
AD = 1 day
ORAF = 1
SA = 2500 cm2

$$\frac{82 * 50 * 0.000001 * 250 * 25 * 1}{72 * 27375} +$$

$$\frac{82 * 0.2 * 0.1 * 1 * 0.000001 * 250 * 25 * 2500}{1 * 72 * 27375}$$

$$= 0.00003 \text{ mg/kg - day}$$

0.00003 mg/kg-day * 0.014 kd-day/mg

$$= 4.2 * 10^{-7}$$

Certification

This Health Consultation was prepared by the Washington State Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

Debra Gable
Technical Project Officer, SPS, SSAB, DHAC
ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

Richard Gillig
Chief, SPS, SSAB, DHAC
ATSDR